Chapter 2

Chemistry

Objectives

- **Describe** the purpose of the scientific method.
- **Distinguish** between qualitative and quantitative observations.
- **Describe** the differences between hypotheses, theories, and models.

Scientific Method

- The **scientific method** is a logical approach to solving problems by observing and collecting data, formulating hypotheses, testing hypotheses, and formulating theories that are supported by data
- *Observing* is the use of the senses to obtain information.
- data may be
  - *qualitative* _____
  - *quantitative* _____

Demo

- A **system** is a specific portion of matter in a given region of space that has been selected for study during an experiment or observation.
- Ex.

- Scientists use generalizations about the data to formulate a **hypothesis**, or testable statement.
- Hypotheses are often "_____" statements
- If a plant receives more light, it will then grow faster
- Testing a hypothesis requires _____ _____
- _____are the experimental conditions that remain constant.
  - A plant that gets 8 hrs of light a day
- _____are any experimental conditions that change.
  - Independent – _____
  - Dependent – _____

- A **model** in science is more than a physical object; it is often an explanation of how phenomena occur and how data or events are related.
  - visual, verbal, or mathematical
    - example: atomic model of matter
  - A **theory** is a broad generalization that explains a body of facts or phenomena.
    - example: atomic theory

Scientific Method - Hawley

- See HO

2.2

Objectives

- **Distinguish** between a quantity, a unit, and a measurement standard.
- **Name** and **use** SI units for length, mass, time, volume, and density.
- **Distinguish** between mass and weight.
- **Perform** density calculations.
- **Transform** a statement of equality into a conversion factor.

Question

- Would you be breaking the speed limit if you were traveling 60 km/h in a 40 mi/h zone?

Measurements represent quantities.

- A **quantity** is something that has _____ _____
- measurement ≠ quantity
  - the teaspoon is a unit of _____
  - volume is a _____
- The choice of unit depends on the quantity being measured.

SI Base Units

Quantity	Quantity symbol	Unit name	Unit abbreviation	Defined standard
Length	l	meter	m	the length of the path traveled by light in a vacuum during a time interval of 1/299 792 458 of a second
Mass	m	kilogram	kg	the unit of mass equal to the mass of the international prototype of the kilogram
Time	t	second	s	the duration of 9 192 631 770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the cesium-133 atom
Temperature	T	kelvin	K	the fraction 1/273.16 of the thermodynamic temperature of the triple point of water
Amount of substance	n	mole	mol	the amount of substance of a system which contains as many elementary entities as there are atoms in 0.012 kilogram of carbon-12
Electric current	I	ampere	A	the constant current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross section, and placed 1 meter apart in vacuum, would produce between these conductors a force equal to 2×10^{-7} newton per meter of length
Luminous intensity	I_v	candela	cd	the luminous intensity, in a given direction, of a source that emits monochromatic radiation of frequency 540×10^{12} hertz and that has a radiant intensity in that direction of 1/683 watt per steradian

SI units

- _____is a measure of the quantity of matter.
  - The SI standard unit for mass is the _____.
- **Weight** is a measure of the _____
_____
  - .
- _____is a measure of distance.
  - The SI standard for length is the _____.

Check 4 Understanding

Derived Units

- _____of SI base units form **derived units**
  - Ex.

Quick Lab

Dimensional Analysis

- **Dimensional analysis** is a mathematical technique that allows you to use units to solve problems involving measurements.
- Would you be breaking the speed limit if you were going 45 km/h in a 55 mph zone?
- To find the answers, you use conversion factors

K h da BU d c m

- Convert from
  - 12 cm → m
  - 125 m → mm
  - 1.5 km/h → m/h
  - 100 km/h → mph (1 km = 0.62 miles)

2.3

Objectives

- **Distinguish** between accuracy and precision.
- **Determine** the number of significant figures in measurements.
- **Perform** mathematical operations involving significant figures.
- **Convert** measurements into scientific notation.
- **Distinguish** between inversely and directly proportional relationships.

- **Accuracy** _____
_____
_____
- **Precision** _____
_____
_____
- **Percentage error** is calculated by subtracting the accepted value from the experimental value, dividing the difference by the accepted value, and then multiplying by 100.

Error

- Some error or uncertainty always exists in any measurement.
  1. _____
  2. _____
  3. _____

- A student measures the mass and volume of a substance and calculates its density as 1.40 g/mL. The correct, or accepted, value of the density is 1.30 g/mL. What is the percentage error of the student's measurement?

Sig Figs

- **Significant figures** in a measurement consist of all the digits known with certainty plus one final digit, which is somewhat uncertain or is estimated.
- The term significant _____ mean certain.

Sig Fig Rules (See HO)

- Rules for significant figures
- All nonzero digits in a measurement are significant, but not all zeros are significant.
  - Ex. 132, 48525448, 22525252525
- Zeros BETWEEN nonzero numbers ARE significant
  - Ex. 1202, 12.202, 12.022
- Zeros after the decimal and before a nonzero number are NOT significant
  - Ex. 0.00025, 0.00000585, 0.0025202
- Zeros after nonzero numbers but before the decimal are NOT significant
  - Ex. 125000, 1200, 450200,
- Zeros after nonzero numbers AND after the decimal ARE significant
- Ex. 0.250, 12.020, 456.5020

Practice

- How many sig figs in the following numbers?
- 123456
- 0.00250
- 1252300
- 50584.2302
- 12500.0

+,-,*,/ sig figs

- Adding and subtracting
  - Cannot be more precise that the _____ precise
- Multiplying and dividing
  - Cannot have _____sig figs than the number with the _____sig figs

Practice

- 2.35+458.3+0.255
- 856.30-0.2548-6
- 455.24*3.4
- 896 / 2